Glycogen Synthesis (Glucose Storage)

Branched glucan (α-(1-4) and (α-(1-6) bonds) formed from glucose and stored as spherical granules (10-40 nm in diameter)

- Promoted by insulin

a. *Linear glycogen chain synthesis – formation of G6P from glucose*

Glucose

ATP ↓ *Glucokinase*

Glucose-6-phosphate (G6P) + ADP

b. *Linear glycogen chain synthesis – formation of G1P from G6P*

Glucose-6-phosphate (G6P)

↓ *Phosphoglucomutase*

Glucose-1-phosphate (G1P)

c. *Linear glycogen chain synthesis – formation of UDP*

Glucose-1-phosphate (G1P)

Uridine triphosphate (UTP) ↓ *UDP-glucose pyrophosphorylase*

Uridine diphosphate glucose (UDPG) + PP_i

d. *Linear glycogen chain synthesis – formation of linear chains*

UDPG

$Glycogen_n$ ↓ *Glycogen synthetase*

$Glycogen_{n+1}$ + UDP

e. *Introduction of α-(1-6) glycogen branches*

Linear Glycogen

↓ *Branching enzyme*

Branches and hence branched glycogen

Figure 1 (part 1). Glucose metabolism

Glycogen Hydrolysis and Glucose Formation

- Promoted by adrenaline (especially muscle)
- Promoted by glucagon (especially liver)

f. Linear glycogen chain hydrolysis

Linear α-(1-4) Glycogen Residues

$+P_i \downarrow$ *Glycogen phosphorylase*

$Glycogen_{n-1}$ + Glucose -1-phosphate (G1P)
[glucose cleaved from non-reducing end]

g. Conversion of G1P to G6P

Glucose-1-phosphate (G1P)

↓ *Phosphoglucomutase*

Glucose-6-phosphate (G6P)

h. Conversion of G6P to glucose

Glucose-6-phosphate (G6P)

↓ *Glucose-6-phosphatase*

Glucose + P_i

i. Glycogen branch point hydrolysis

Branched α-(1-6) Glycogen Residues

↓ *Transferase/ debranching enzyme*

Linear Glycogen from transferase activity from α-(1-6) bond

+

Glucose from branch residue (debranching/glucosidase activity)

Note: Blood glucose is maintained at about ~4.5mmol l^{-1} in man.

Figure 1 (part 2). Glucose metabolism

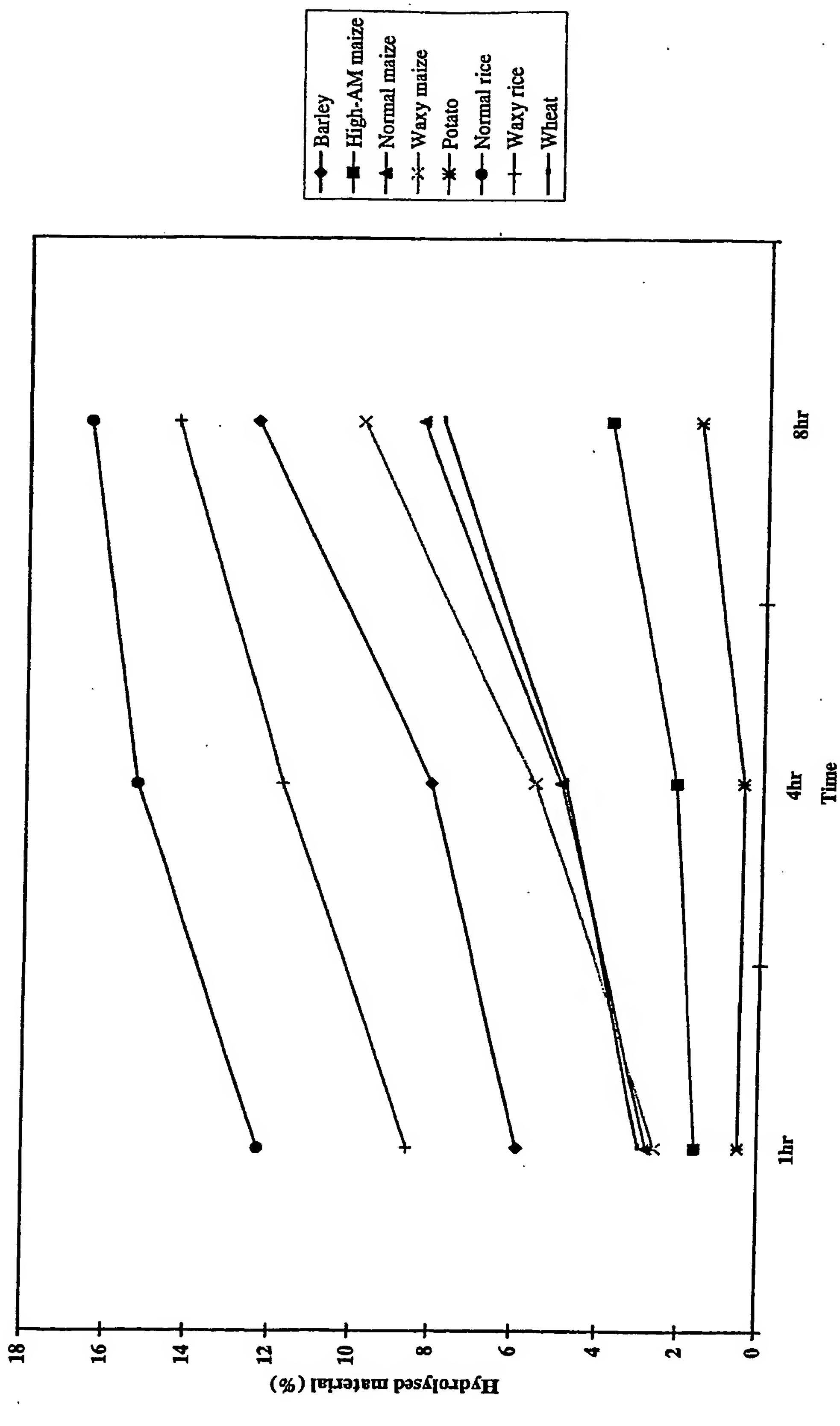

Figure 2: Comparison of the hydrolysis profile of native starches using the Karkalas *et al* (1992) procedure.

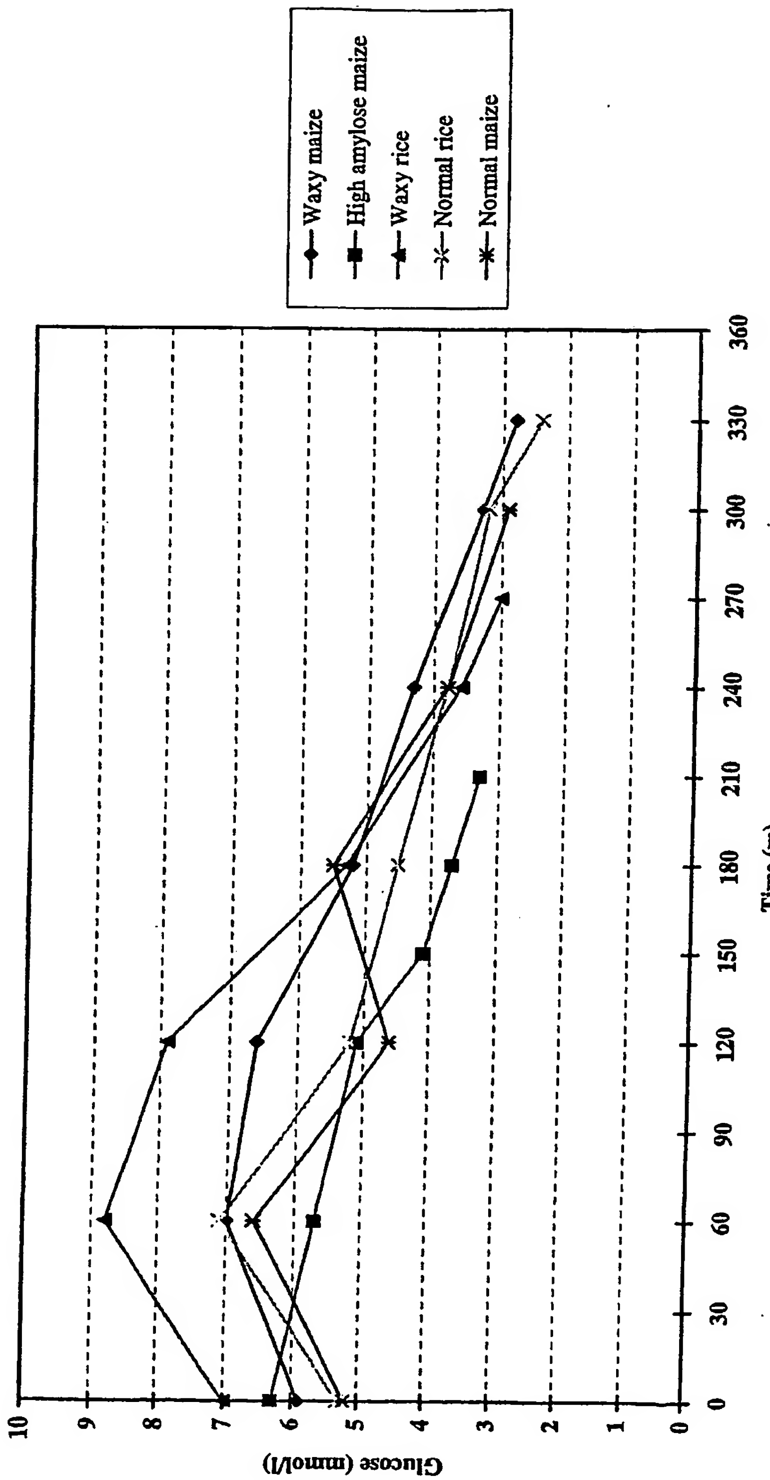

Figure 3: Blood glucose level after consumption of native starches

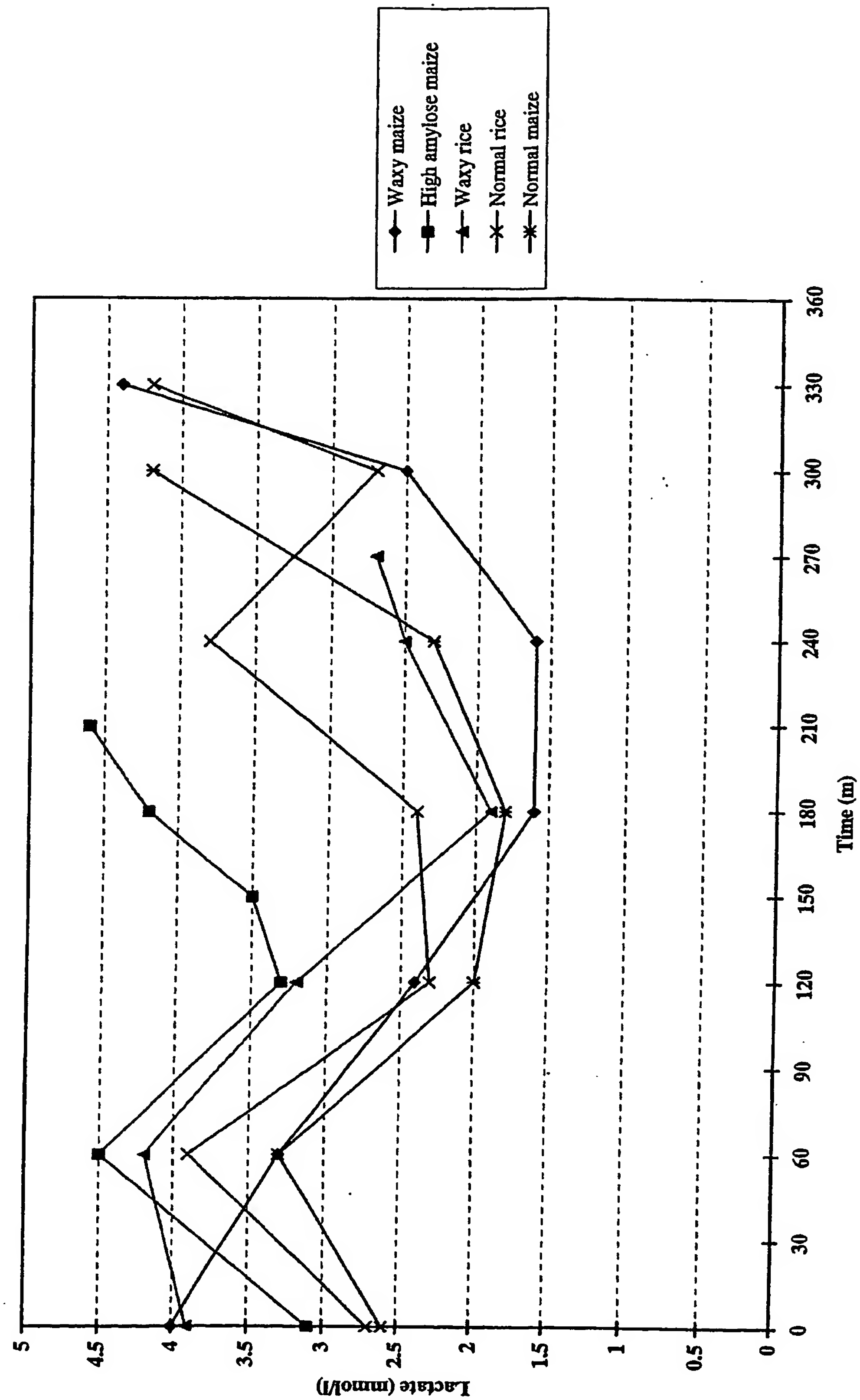

Figure 4: Comparison of the blood lactate level after consumption of native starches

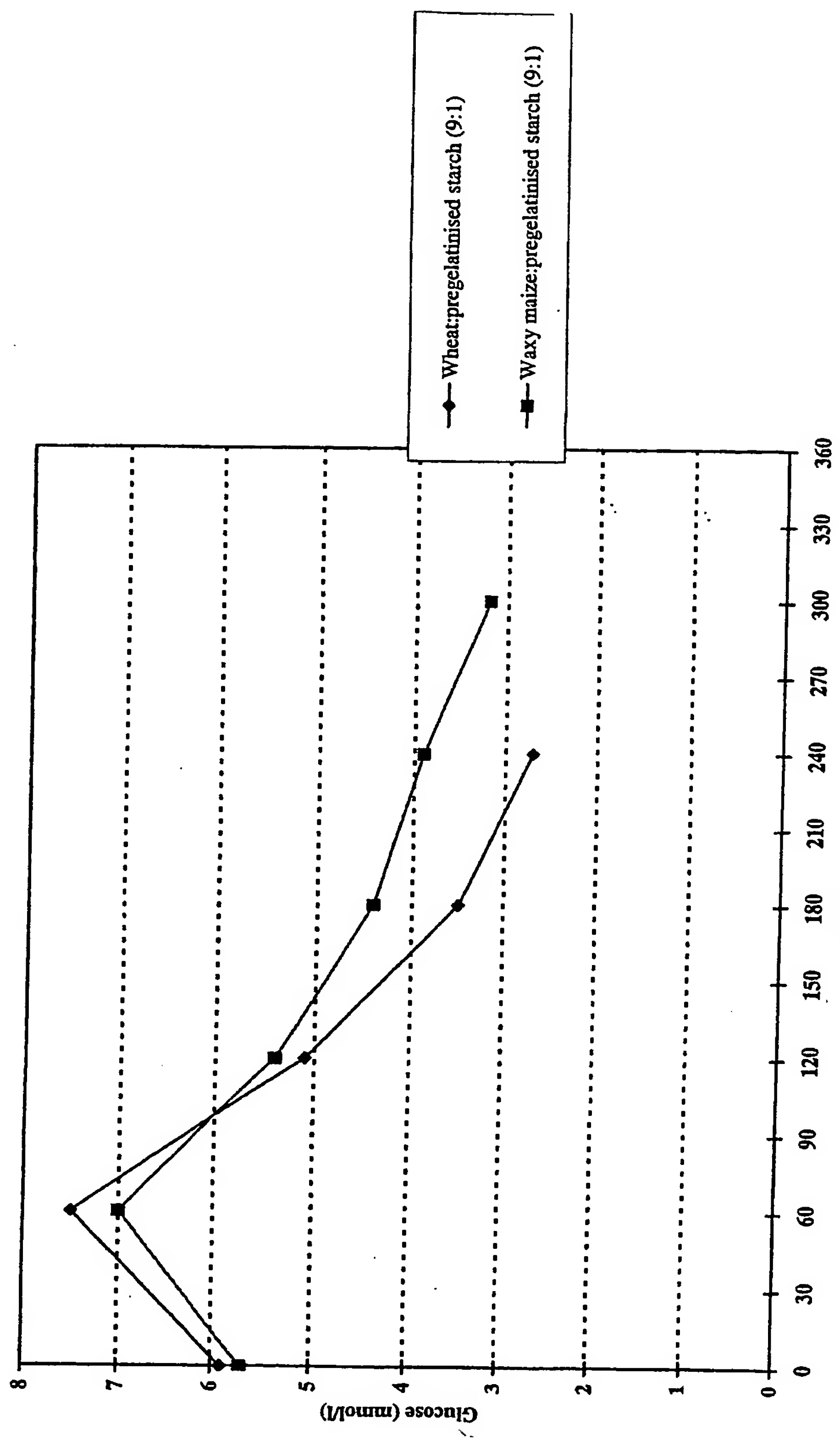

Figure 5: Comparison of blood glucose after consumption of two native starches (wheat and waxy maize) with added pregelatinised (maize) starch.

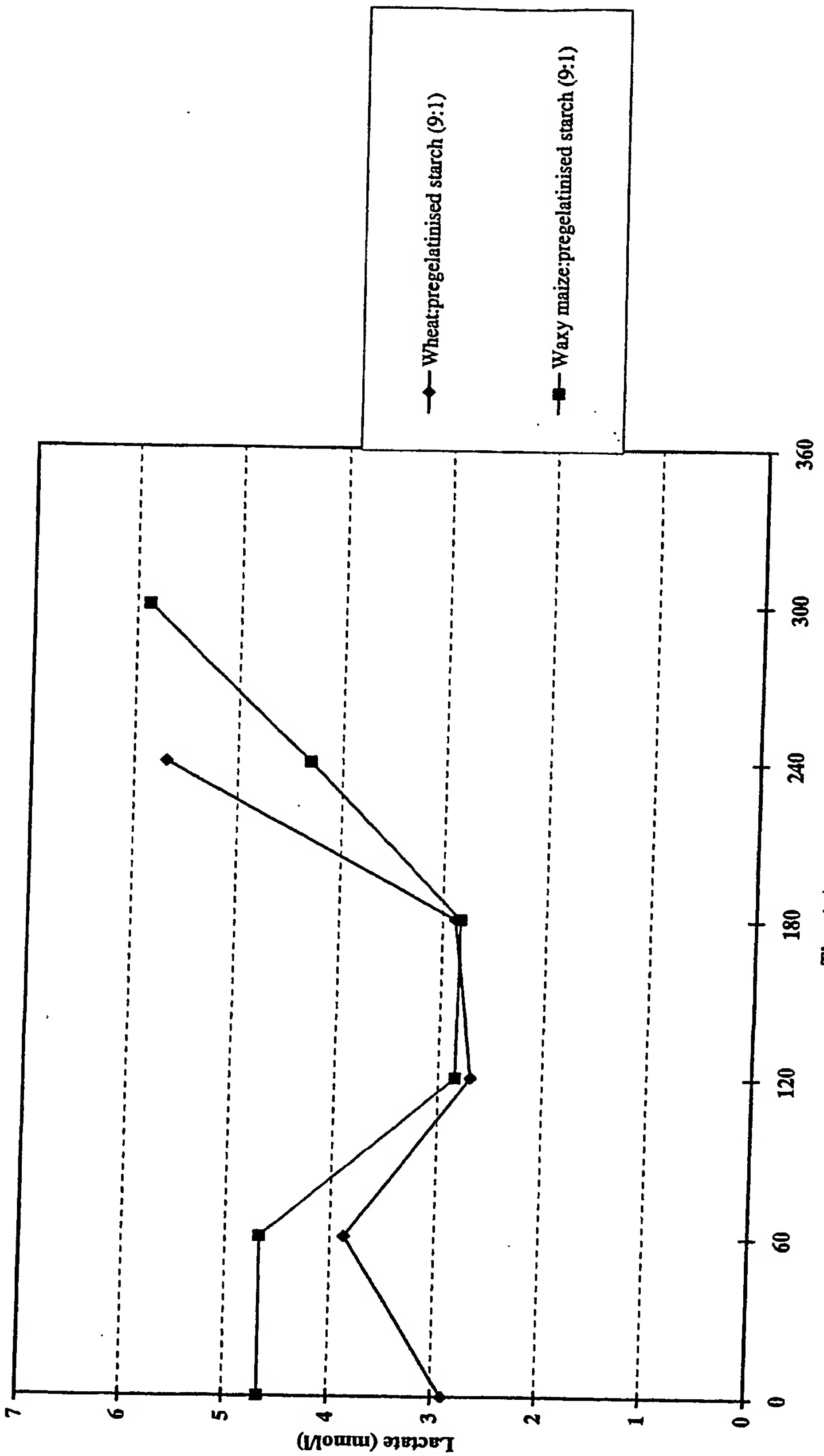

Figure 6: Comparison of the blood lactate level after consumption of two native starches (wheat and waxy maize) with added pregelatinised (maize) starch

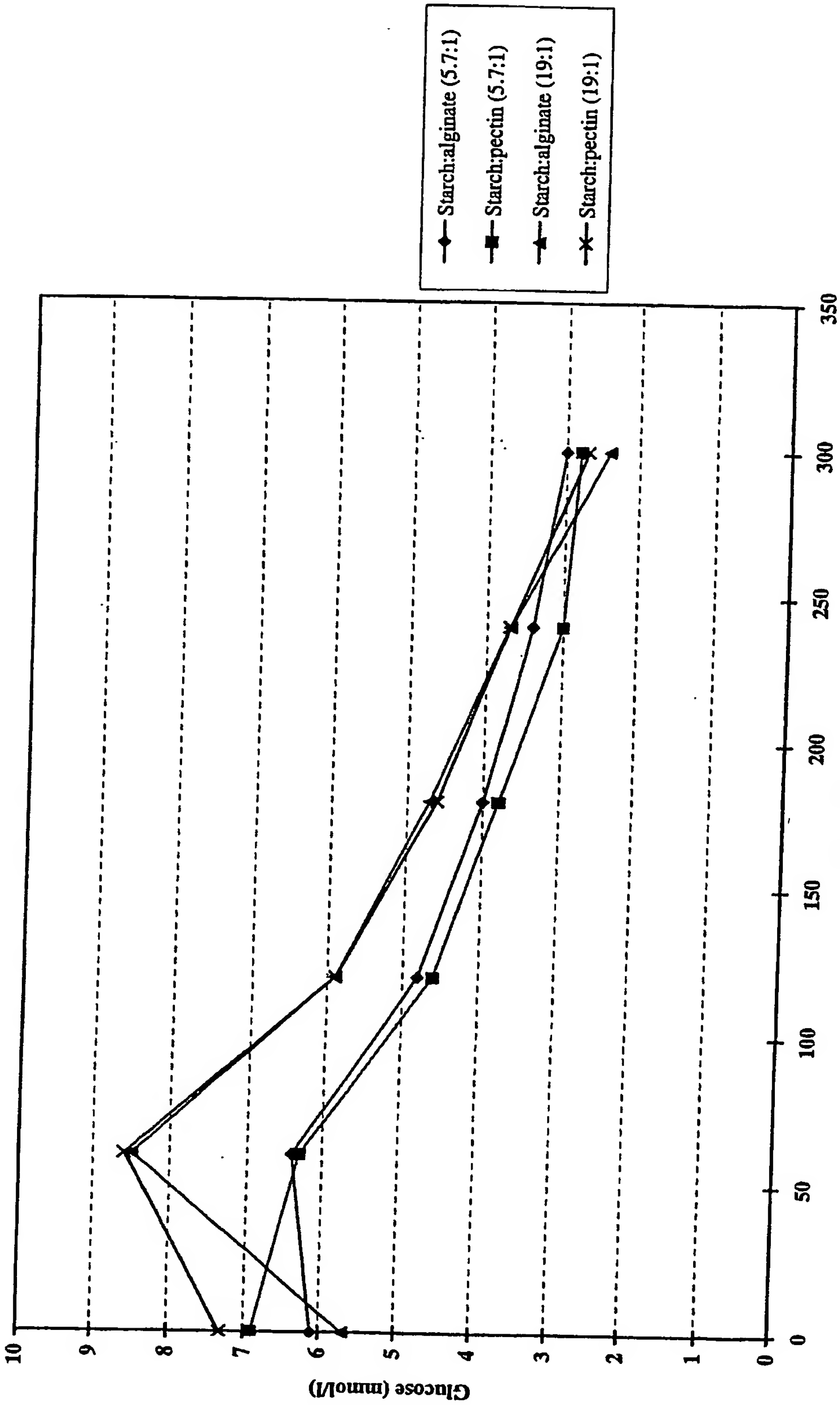

Figure 7: Comparison of blood glucose after consumption starch (native waxy maize and soluble) encapsulated with pectin or alginate.

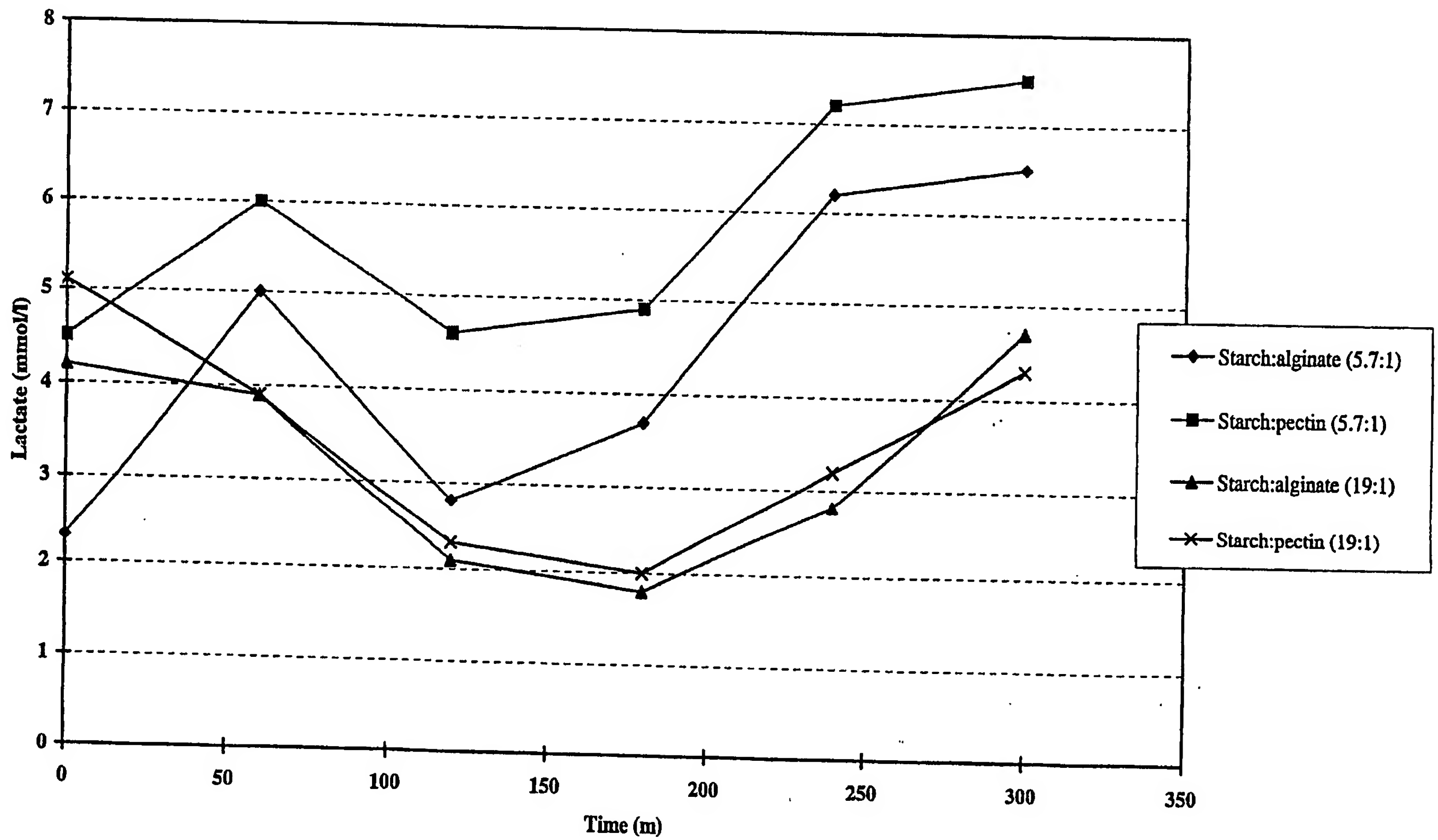

Figure 8: Comparison of blood lactate after consumption of starch (native waxy maize and soluble) encapsulated with pectin or alginate

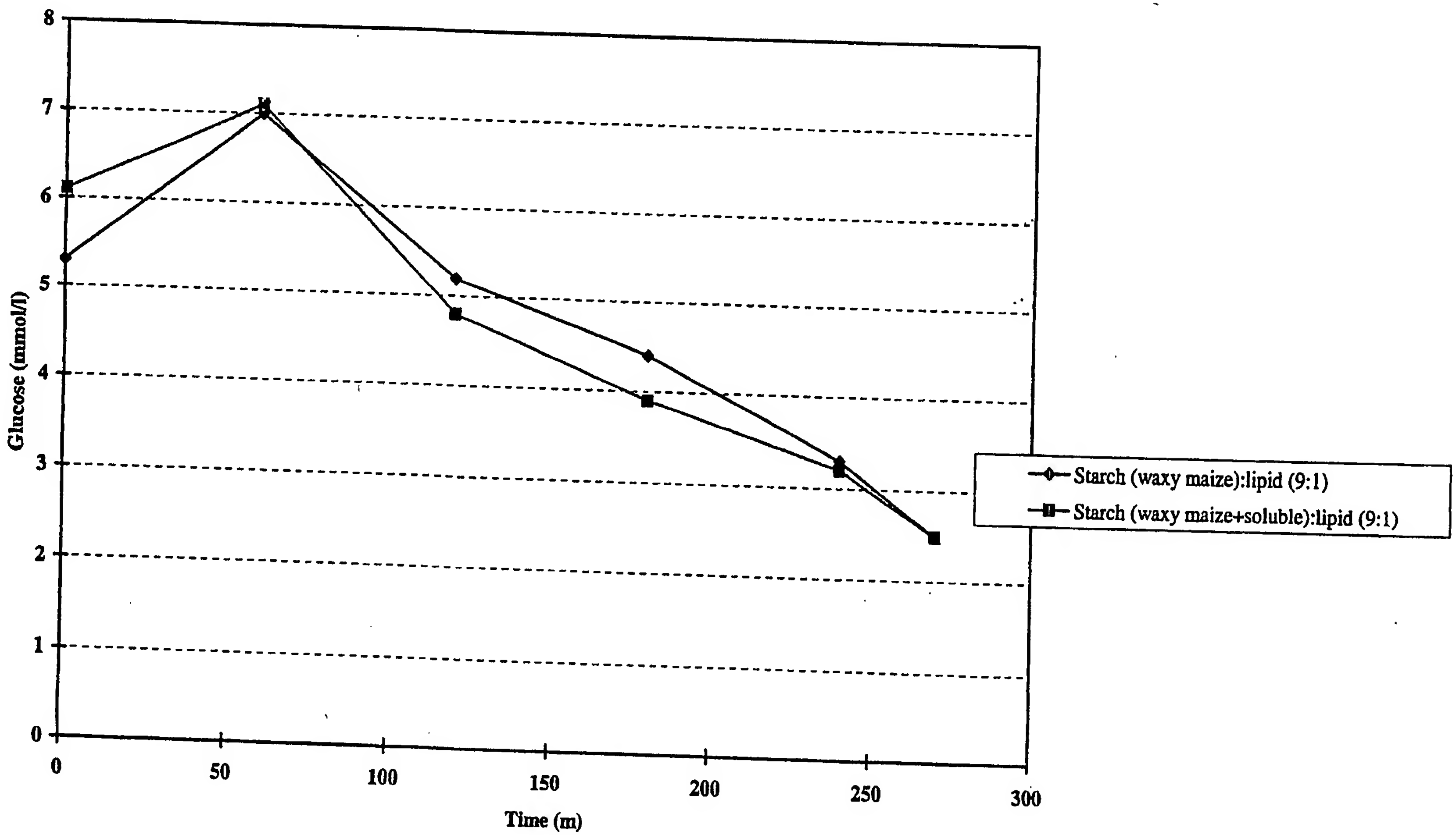

Figure 9: Comparison of blood glucose after consumption of starch (native waxy maize, soluble) encapsulated with lipid

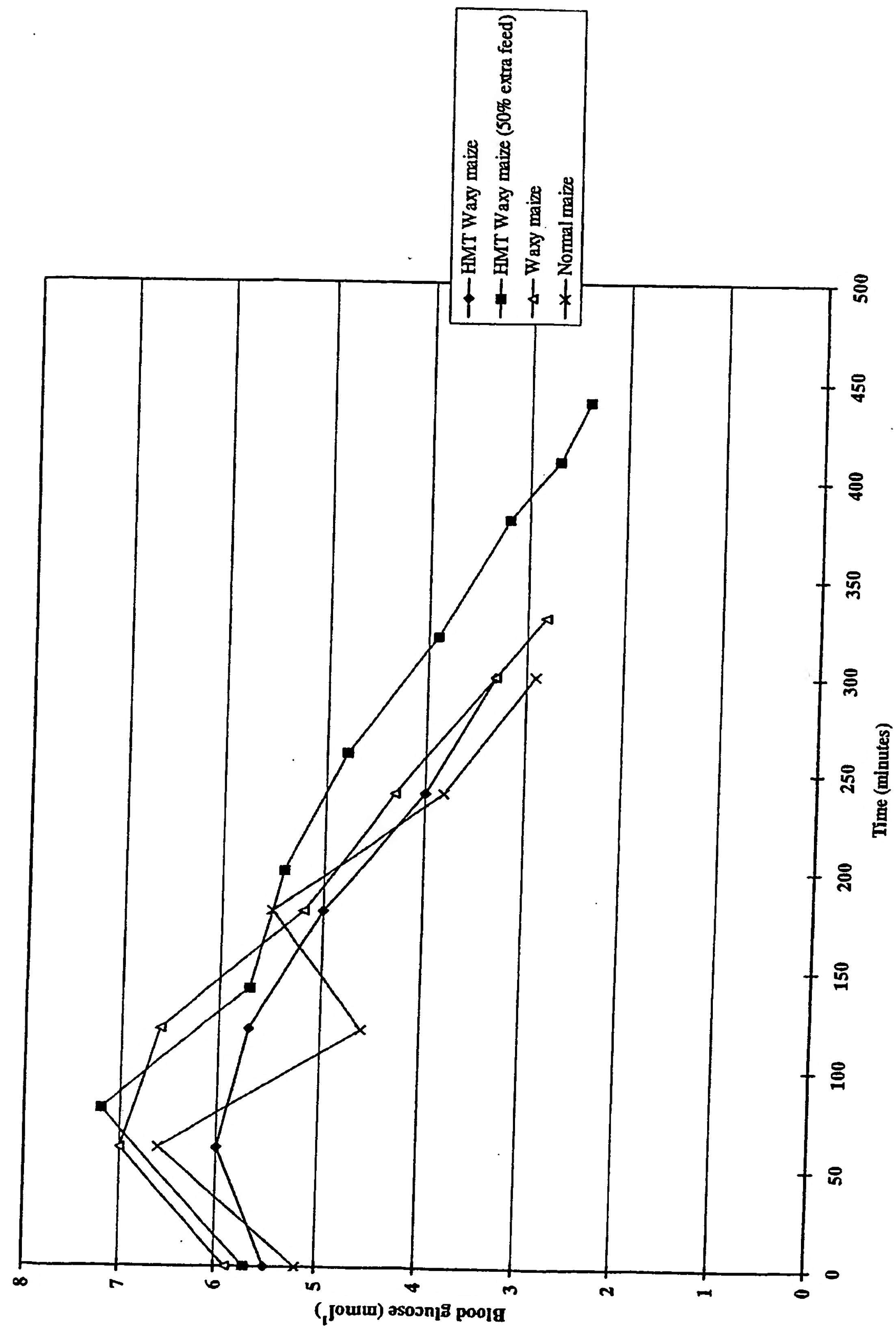

Figure 10: Comparison of blood glucose after consumption of heat-moisture treated waxy maize starch, waxy maize and normal maize starch.

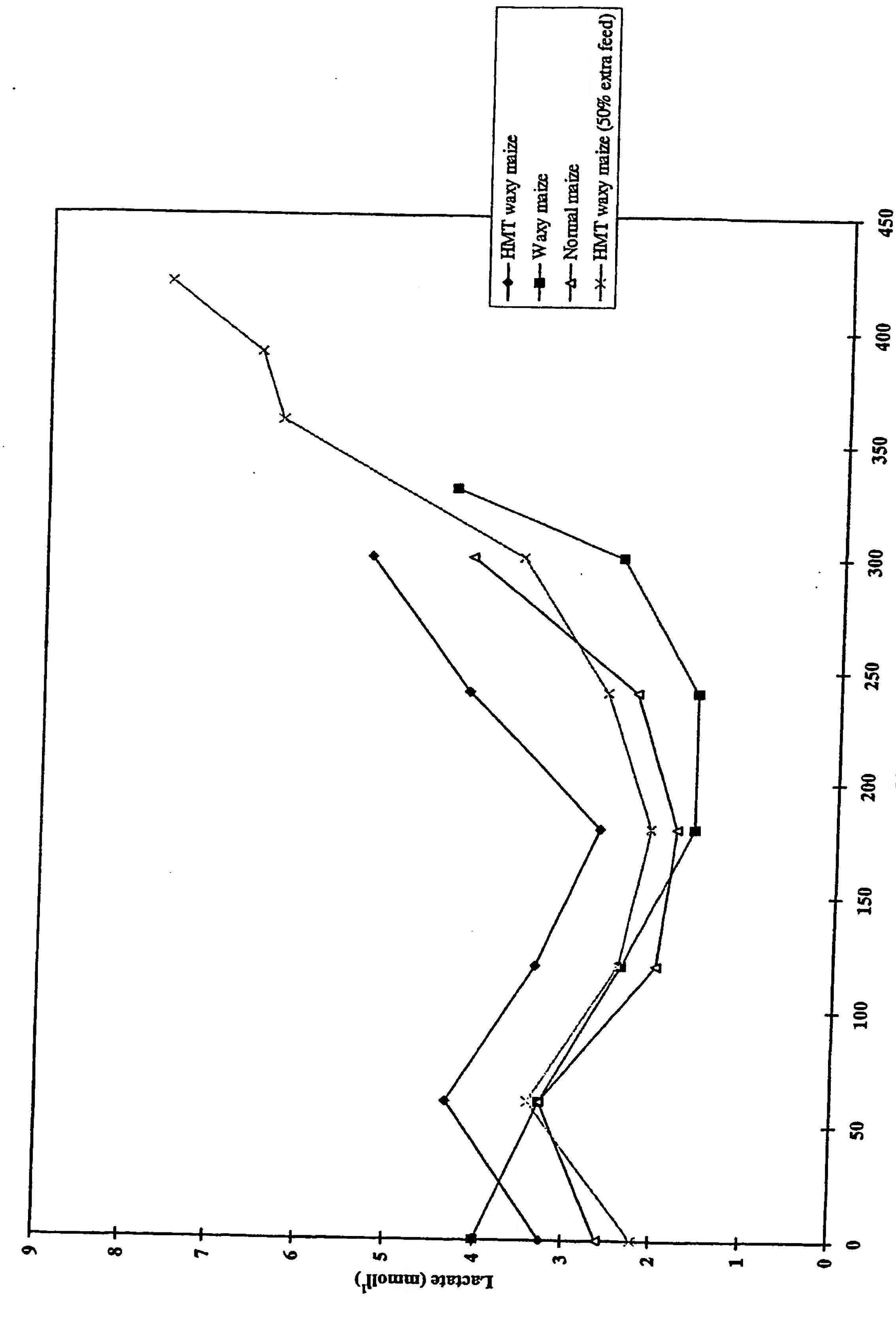

Figure 11: Comparison of blood lactate after consumption of waxy maize, normal maize and heat-moisture treated waxy maize starches.

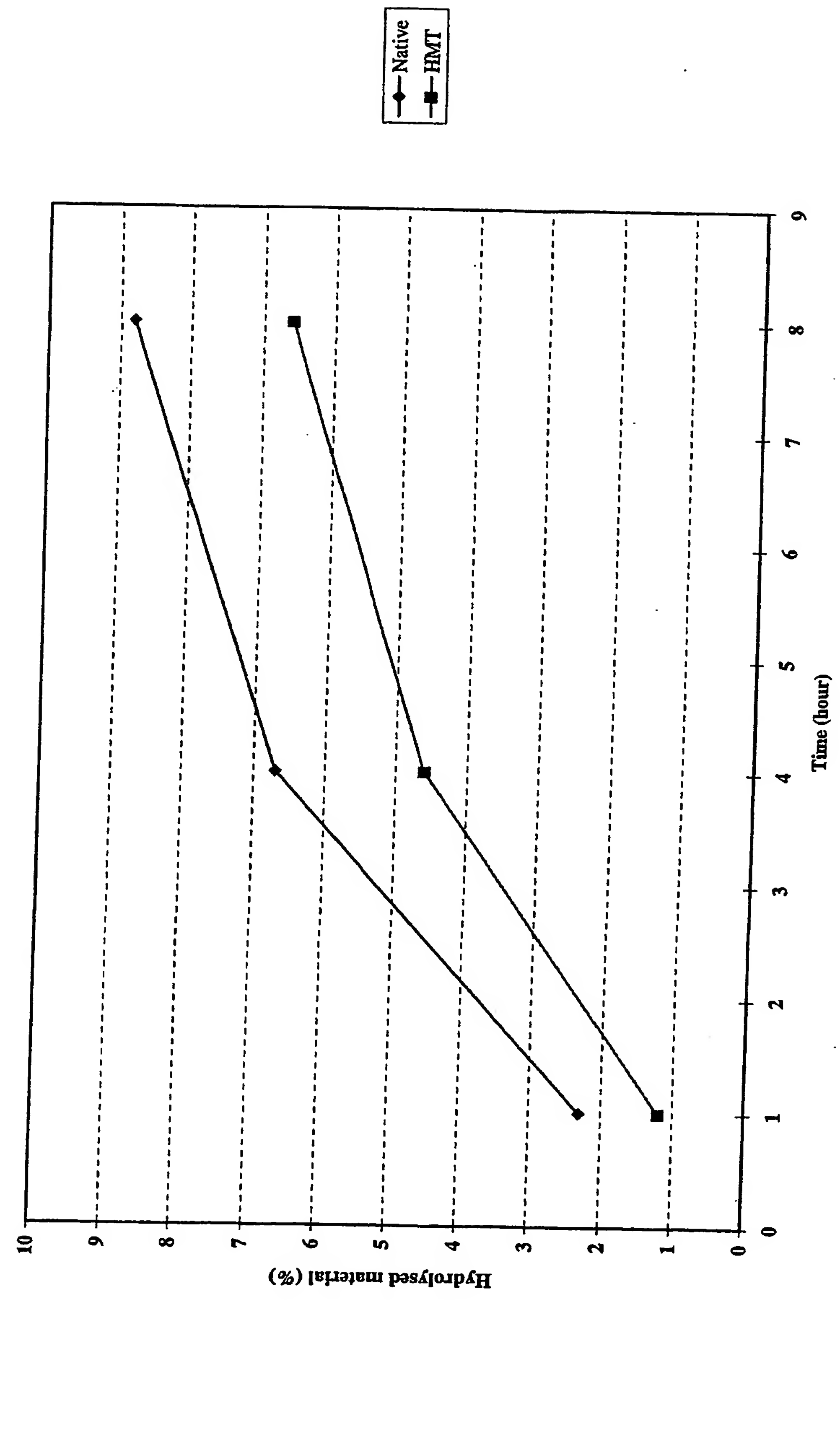

Figure 12: Comparison of digestibility of native and heat-moisture treated waxy maize starches

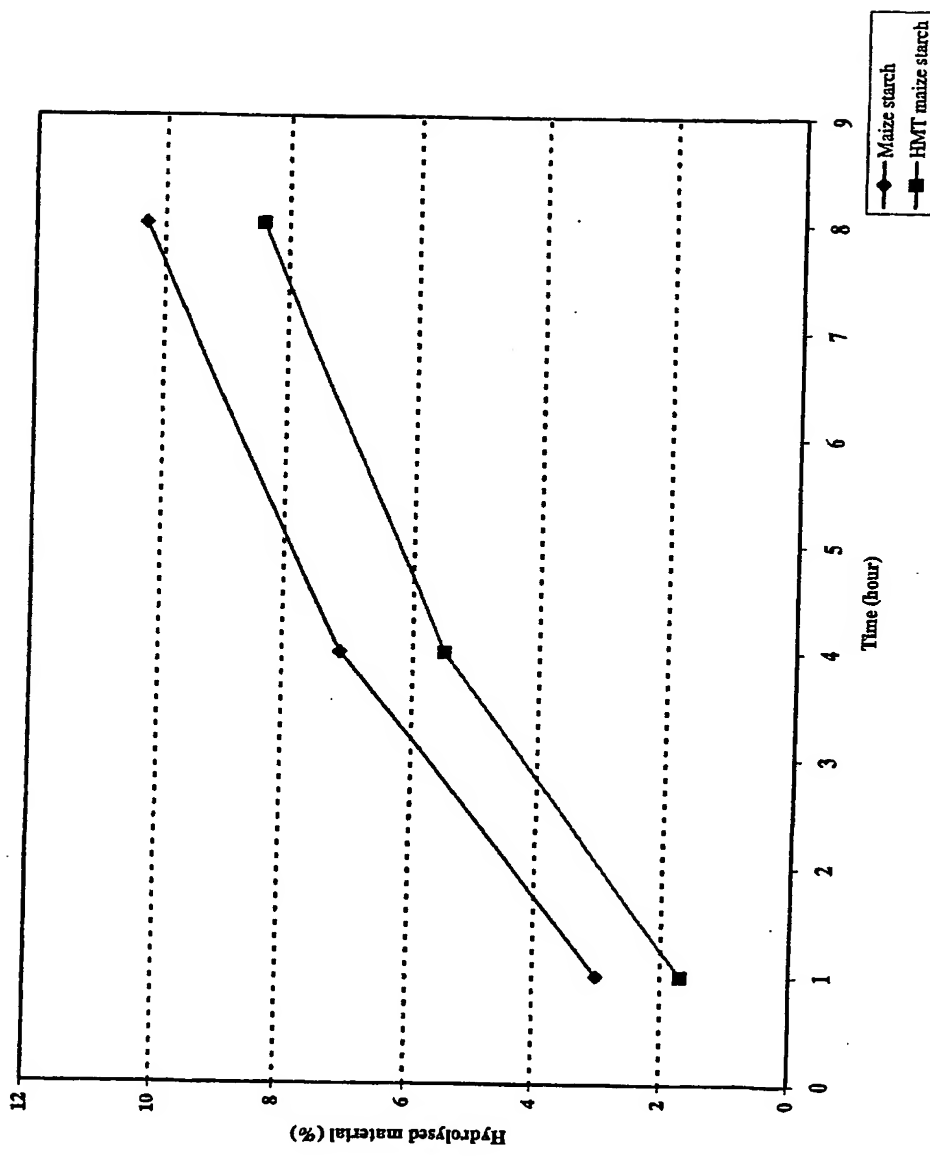

Figure 13: Comparison of digestibility of native and heat-moisture treated maize starches